# HIGH RELIABILITY DC POWER DISTRIBUTION SYSTEM (HRDCPDS) FOR CRITICAL POWER ENVIRONMENTS (DC-UPS)

A PATENT PENDING SYSTEM PRESENTATION

Mark Baldwin - President

Baldwin Technologies, Inc.

David Geary, PE - VP of Engineering

Baldwin Technologies, Inc.



# THOMAS ALVA EDISON

– **1889** SCIENTIFIC AMERICAN

"My personal desire would be to prohibit entirely the use of alternating currents.

They are as unnecessary as they are dangerous. I can therefore see no justification for the introduction of a system which has no element of permanency and every element of danger to life and property"



# <u>INTRODUCTION</u>

High density computer environments, utilizing Alternating Current (AC) power supply blade server technology, are presenting major challenges to owners and operators. Typical facility infrastructures cannot accommodate the added heat loads and reliability requirements of such installations.

Servers equipped with Direct Current (DC) power supplies, instead of AC power supplies, operate with 20-40% less heat, reduce power consumption by up to 30%, increase server reliability, offer flexibility to installations and decrease maintenance requirements.

Utilizing current off-the-shelf components, it is possible to install and operate a high reliability DC power distribution system for a DC powered server environment - without batteries or complicated AC power system drawbacks. This High Reliability DC Power Distribution System could be the next generation power system for server environments.



# <u>ABSTRACT</u>

- Recent tests show the ease of combining new technology DC power systems together to create a high reliability system topology in a building block methodology
- -A DC system topology offers cost savings, higher reliability and reduced maintenance requirements
- DC power distribution eliminates the need for static switches and paralleling controls
- DC power distribution is not susceptible to harmonic problems
- DC powered servers will eliminate 20-40% of the heat load from the typical racked configuration
- DC power distribution is the future

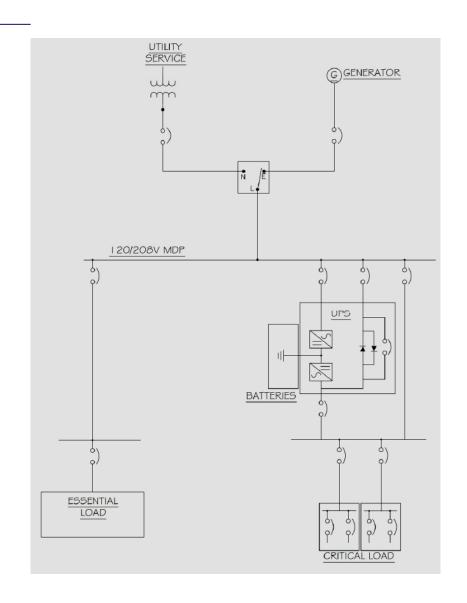


# **TODAY'S ENVIRONMENT**

- THE ALTERNATING CURRENT (AC) WORLD
- HIGH COST LOW EFFICIENCY/HIGH LOSS -MAINTENANCE INTENSIVE
- PARALLEL OPERATION REQUIRES HIGH COST ACTIVE PARALLELING CONTROLS
- AC POWERED BLADE SERVERS CANNOT BE ACCOMMODATED WITHIN THE TYPICAL DATA CENTER FNVIRONMENT
- MULTIPLE CONVERSIONS REQUIRED:
  - AC (UTILITY) to DC (UPS INPUT) to AC (UPS OUTPUT) to DC (WITHIN DATA PROCESSING POWER SUPPLIES)

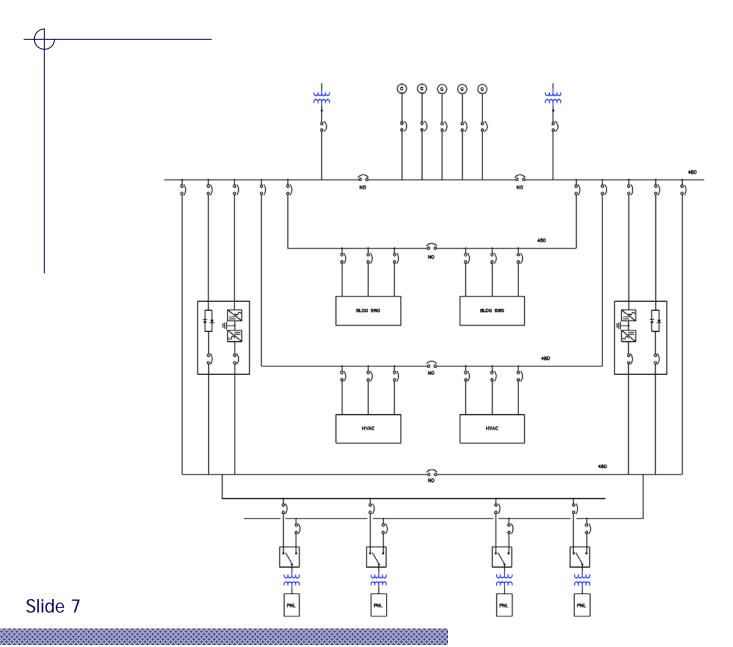


# TYPICAL SMALL AC POWER SYSTEM UP TO APPROX. 300KVA



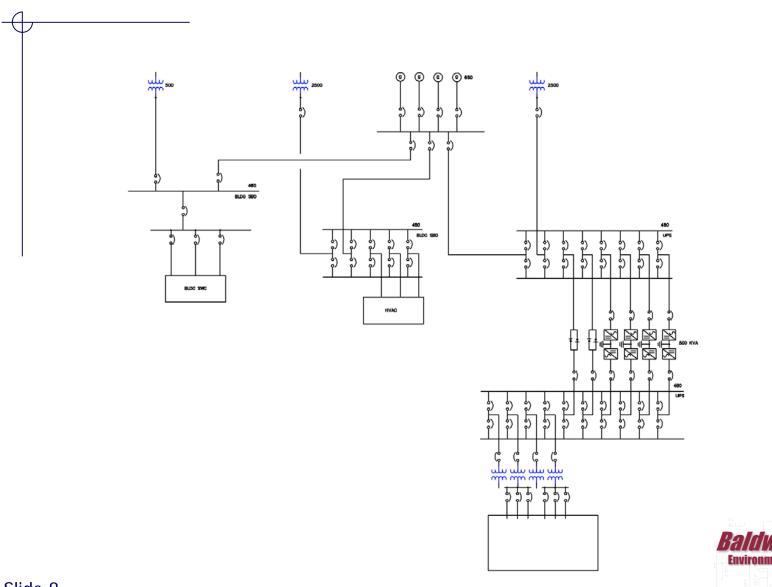


# TYPICAL MEDIUM AC POWER SYSTEM UP TO APPROX. 1,000KVA





# TYPICAL LARGE AC POWER SYSTEM UP TO APPROX. 2,000KVA



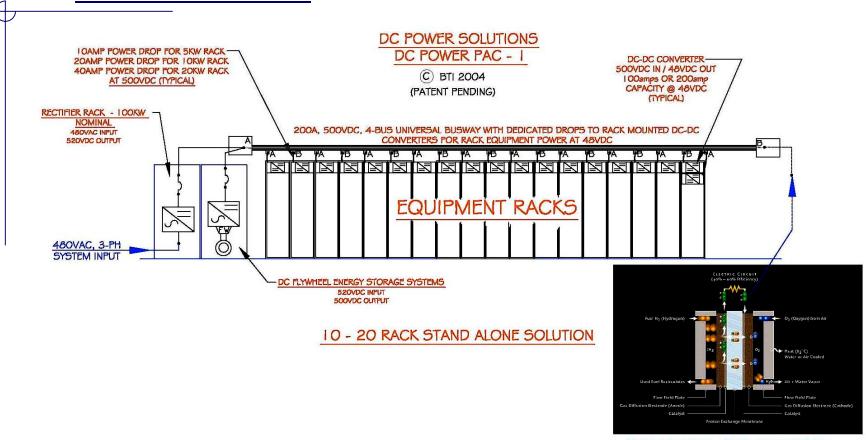


# **TOMORROW'S ENVIRONMENT**

 Recent developments by multiple manufacturers, for component parts of a DC based distribution system, now make it possible to install off-the-shelf equipment in order to provide a High Reliability DC Power Distribution System for critical environments.



# DC POWER SOLUTIONS DC POWER PAC - 1



FUTURE FUEL CELL INTERFACE



# <u>DEMONSTRATION SYSTEM - CHATSWORTH, CA. - PENTADYNE</u> <u>POWER HQ</u>





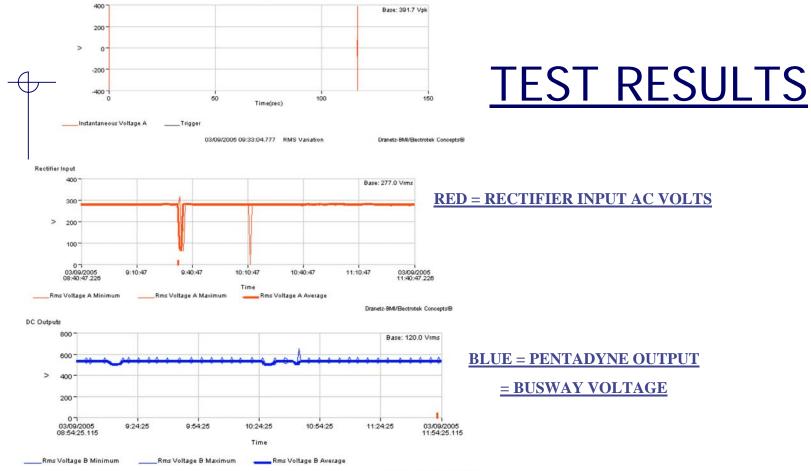


# <u>DEMONSTRATION SYSTEM - CHATSWORTH, CA. - PENTADYNE</u> <u>POWER HQ</u>

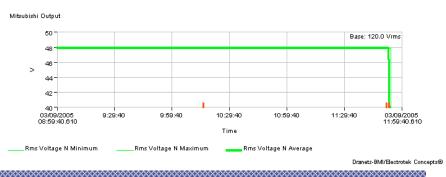








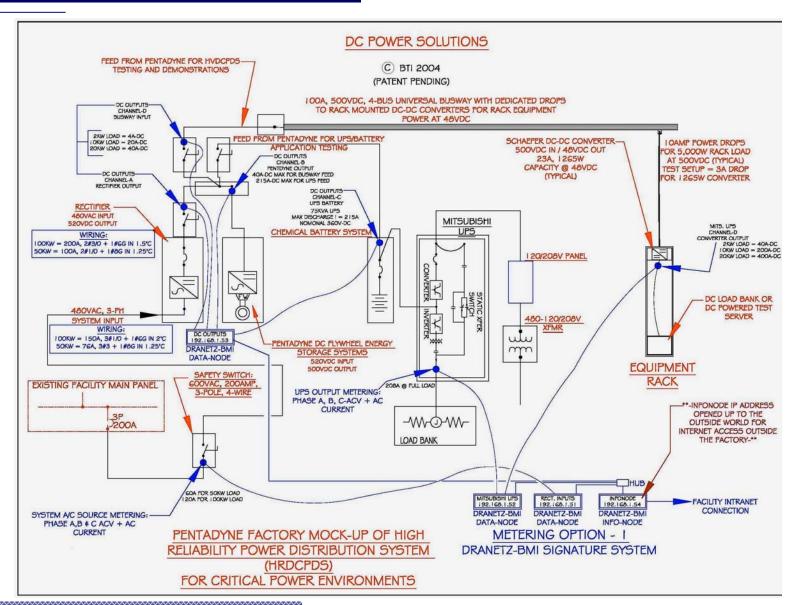
Dranetz-BMI/Electrotek Concepts®



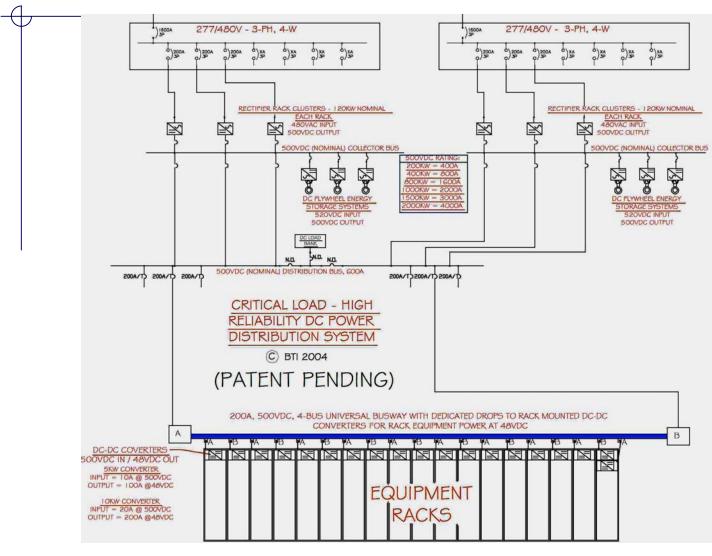
GREEN = DC-DC CONVERTER
OUTPUT



# TEST SET-UP 1-LINE



# DC POWER SOLUTIONS DC POWER PAC - 2





### COMPONENT PARTS OF THE DC POWER DISTRIBUTION SYSTEM

#### RECTIFIERS: -

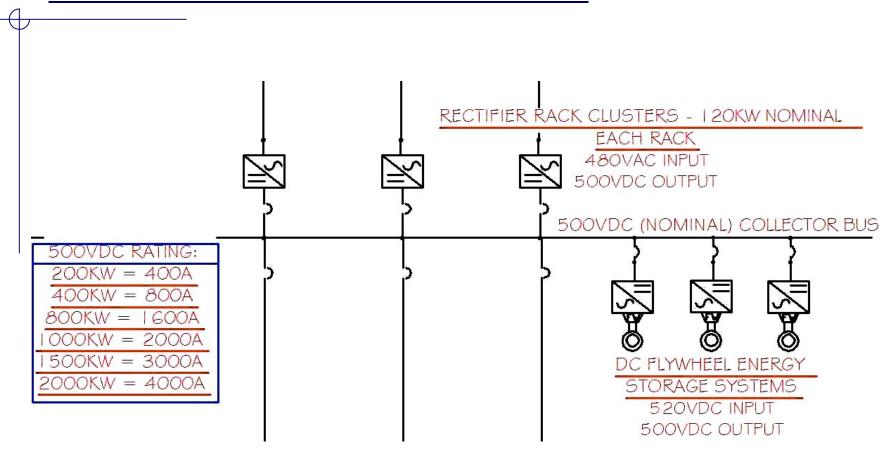
 CONVERTS UTILITY OR GENERATOR SOURCED AC POWER TO 500VDC (NOMINAL) IN ANY COMBINATION OF BUILDING BLOCK SIZING FOR CAPACITY AND/OR REDUNDANCY

### ENERGY STORAGE: -

PROVIDES DC POWER RIDE THROUGH WITHOUT BATTERIES. UPON LOSS OF THE AC POWER SOURCE TO THE RECTIFIERS, THE PENTADYNE FLYWHEEL TECHNOLOGY BASED SYSTEM WILL SUPPORT THE 500VDC BUS WHILE ENGINE GENERATORS ARE BROUGHT ON LINE



# **RECTIFIER AND FLYWHEEL CONFIGURATION**





# <u>COMPONENT PARTS OF THE DC POWER DISTRIBUTION SYSTEM - CONT'D</u>

### EQUIPMENT RACK DISTRIBUTION: -

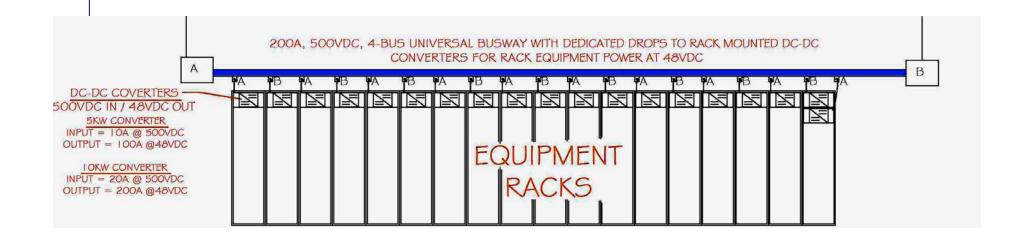
PROVIDES UL LISTED 500VDC POWER DISTRIBUTION TO EQUIPMENT RACK LOCATIONS WITHIN A COMPACT PACKAGE WITH HOT SWAPPABLE / MOVABLE CONNECTORS. BUSWAY HAS THE CAPABILITY OF BEING FED FROM 2 SEPARATE 500VDC SOURCES FOR REDUNDANCY

### DC - DC VOLTAGE CONVERTERS: -

■ TAKES 500VDC POWER INPUT AND CONVERTS POWER TO LOW VOLTAGE DC (48VDC, 24VDC, 5VDC, ETC.) AS REQUIRED AT THE RACK EQUIPMENT. RACK EQUIPMENT CAN BE PROVIDED WITH MORE EFFICIENT AND COST EFFECTIVE DC POWER SUPPLIES.



# EQUIPMENT RACK DISTRIBUTION & DC-DC VOLTAGE CONVERTER CONFIGURATION





# <u>EQUIPMENT MAINTENANCE & MANAGEMENT SYSTEM FOR</u> <u>CRITICAL ENVIRONMENTS</u>

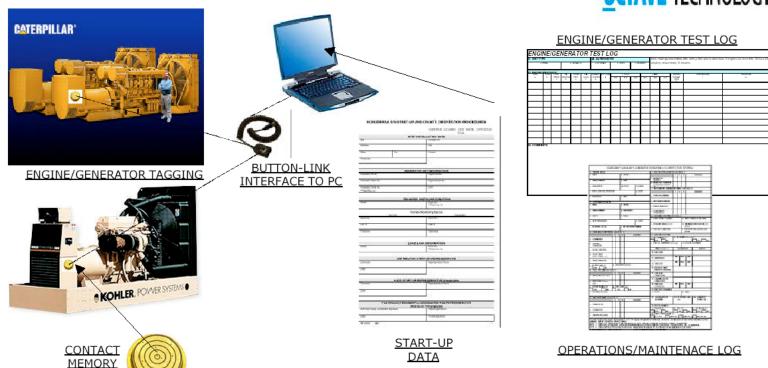
- Octave Technology, Inc-
  - MAINTENANCE AND ACCURATE RECORDS ARE KEY TO THE RELIABILITY OF ANY CRITICAL ENVIRONMENT
  - OCTAVE TECHNOLOGY HAS DEVELOPED A HIGH TECHNOLOGY BASED SYSTEM TO STORE CRITICAL EQUIPMENT OPERATIONAL AND MAINTENANCE DATA ON THE EQUIPMENT ITSELF
  - OCTAVE TECHNOLOGY HAS DEVELOPED SYSTEMS TO MANAGE SELF-DESCRIBING ASSETS
- DRANETZ-BMI Signature System for PQ Metering-
  - INTERNET BASED POWER QUALITY METERING
  - METER DATA ACCESS ANYWHERE INTERNET ACCESS IS AVAILABLE
  - PROVIDES HISTORIC AND REAL TIME POWER QUALITY METERING DATA AT ALL CRITICAL POINTS WITHIN THE SYSTEM
  - PROVIDES DATA FOR AC AND DC POWER MONITORING POINTS AT THE SAME TIME



### **EQUIPMENT MAINTENANCE & MANAGEMENT SYSTEM EXAMPLES**

# **ENGINE/GENERATOR TAGGING**





The MegaButton™ with memory capacities of 1, 2, 4 and 8 Megabytes is a rugged data storage device designed for use and survival in harsh operating environments. Attached to equipment and related components, MegaButtons offer extended data storage capabilities, allowing large amounts of information; maintenance or technical manuals, schematic diagrams, x-rays, and pictures to be stored on the button along with nameplate, configuration and maintenance data.

Features

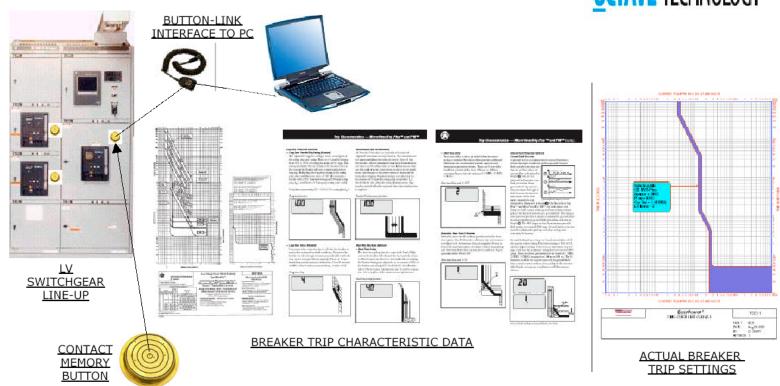
BUTTON

TYPES OF INFORMATION THAT CAN BE STORED ON CONTACT MEMORY BUTTON WHICH CAN BE DOWN-LOADED TO A PC

### **EQUIPMENT MAINTENANCE & MANAGEMENT SYSTEM EXAMPLES**

# LV BREAKER TAGGING





**Features** 

The MegaButton™ with memory capacities of 1, 2, 4 and 8 Megabytes is a rugged data storage device designed for use and survival in harsh operating environments. Attached to equipment and related components, MegaButtons offer extended data storage capabilities, allowing large amounts of information; maintenance or technical manuals, schematic diagrams, x-rays, and pictures to be stored on the button along with nameplate, configuration and maintenance data.

TYPES OF INFORMATION THAT CAN BE STORED ON CONTACT MEMORY BUTTON WHICH CAN BE DOWN-LOADED TO A PC

### **EQUIPMENT MAINTENANCE & MANAGEMENT SYSTEM EXAMPLES**

# SYSTEM METERING FOR TESTING DOCUMENTATION – DRANETZ-BMI Signature System:

The Dranetz-BMI Signature System represents the state of the art in power monitoring systems. It combines the latest in power monitoring technology with broadly available technologies such as the Internet web browser and the World Wide Web.

The Signature System is a full featured power monitoring system that combines low cost power/flow monitoring along with low cost full power quality monitoring in one easy to use system. A unique feature of this system is there is no manufacturer's software required to collect and analyze data. All interactions with the monitoring system are via the common web browser, such as Internet Explorer. The advantages to this approach are many: No proprietary software to load, no software licensing, access to data from anywhere that has connectivity to the monitoring system, via network or modem.

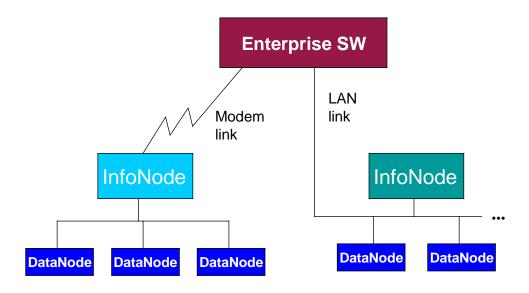


Figure 1. Basic Architecture of the Signature System.



# Signature System

- Power Quality
- High Freq. Transients
- Demand/Energy
- AC and DC Capable
- IP Communications
- Intelligent Answer Modules

- Web Enabled User Interface
- Built-in web server
- Internet, Intranet, Local network communications
- No PC software required
- Easy to use







# SYSTEM SPECIFIC EQUIPMENT INFORMATION



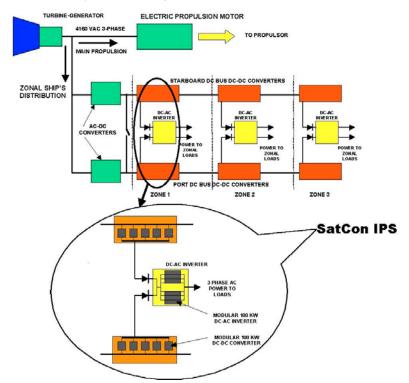
# RECTIFIERS & DC - DC CONVERTERS

■ BALDWIN TECHNOLOGIES, INC. is working with SATCON POWER SYSTEMS to develop high efficiency rectifiers and dc-dc converters specific for this system architecture application.

 SATCON is currently providing power conversion products for the Navy's new DD(X) destroyer program for a DC based Integrated Power

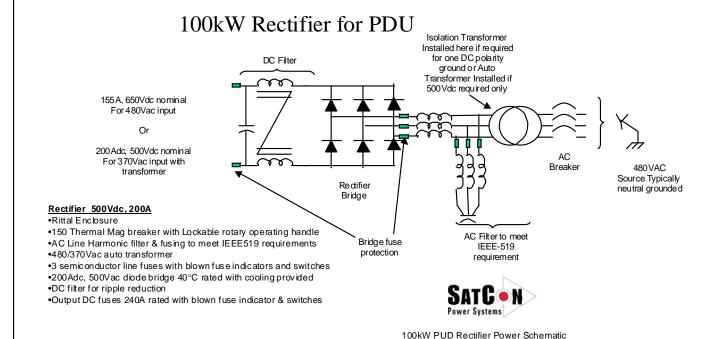
System.







# POSSIBLE RECTIFIER CONFIGURATION



**Baldwill** Technologies Inc Environmental Support Solutions

# PENTADYNE POWER CORPORATION - VOLTAGE SUPPORT SOLUTION FOR THE ENERGY STORAGE DEVICE



# PENTADYNE FLYWHEEL TECHNOLOGY VOLTAGE SUPPORT SOLUTION (VSS)

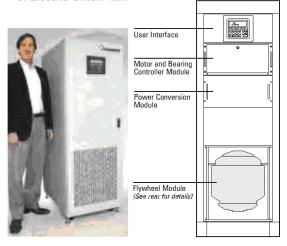
The Pentadyne VSS design employs a carbon-fiber flywheel with an integral synchronous reluctance motor-generator, weighing just 52 pounds, spinning at 60,000 RPM in a vacuum chamber. The wheel is fully levitated by magnetic bearings resulting in no mechanical wear. A double walled, double container construction with a fluid buffer safely contains flywheel energy. An internal molecular vacuum pump built into the system requires no maintenance. Compared to other flywheel designs, the VSS is low weight and has a small footprint; it can be easily installed on a computer room raised floor or other non-conditioned space. A 15-year maintenance life design yields lower maintenance costs and less downtime for maintenance shutdowns. Consuming a miserly 300-Watts when idling, the VSS system is very efficient: 99.9% in standby. Unlike a battery, it can recharge in almost the same time as the discharge time, and therefore has higher availability, which is important in situations where multiple disturbance events occur in a short time frame.



#### Pentadyne Voltage Support Solution™

The Pentadyne Voltage Support Solution™ provides ride-through power and voltage stabilization in a variety of areas, including:

- 1. Uninterruptible Power Supply (UPS)
- 2. Adjustable Speed Drive (ASD)
- 3. Distributed Generation (DG)
- 4. Utility Premium Power
- 5. Electric Urban Rail



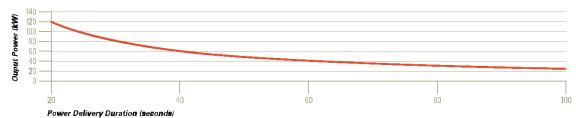
#### **Specifications**

•		
Rated Power	120 kW	
Duration at Rated Power	20 seconds	
Useable Energy Storage	0.67 kW.h (2400 kW.s)	
Max. Recharge Power	120 kW	
Typical Idle Power Consumption	300 W	
Total Weight	590 kg (1300 lb)	
Dimensions ( W x D x H )	63 x 83 x 180 cm (25 x 33 x 71 in.)	
Operating Temperature	-20°C to 50°C (-4°F to 122°F)	
Non-operating Temperature	-20°C to 80°C (-4°F to 176°F)	
Output Voltage	500 to 850 VDC*	
Output Voltage Regulation	+/- 5% DC	
Weatherproof Enclosure	Optional	
Forklift Compatible	Yes	

<sup>\*</sup>Parameters are set by the user through the Pentadyne system "user interface" console; for other voltages, please consult Pentadyne.

#### **Operational Flexibility**

The Pentadyne *Voltage Support Solution*™ can provide clean constant DC output (or AC output with optional hardware) for 20 seconds at 120 kW or other combinations of power and time equaling 2400 kW-seconds of energy (as shown below).





#### Pentadyne Voltage Support Solution™

#### Pentadyne Flywheel Technology. Unique technology features create unique economic benefits.

Superior customer economic benefits come from Pentadyne Power Corporation's choice of innovative technologies, which include:

#### **Features**

#### · Active magnetic bearings

- · Internal, integrated vacuum system
- · Synchronous reluctance motor-generator
- · Fiber composite flywheel
- Unique patented safety system

#### **Economic Benefits**

- No mechanical losses
- · Very low aerodynamic losses
- · Very low standby losses
- · Low cost energy storage
- · Low installation cost

Pentadyne's flywheel technology provides precise electrical power for ride-through and voltage stabilization during electrical disturbances.

#### The Pentadyne Flywheel Module

Molecular Vacuum Pump

Carbon Fiber Flywheel

Stator

Liquid Cooling Passages

Lower Magnetic Bearing

Outer Housing

#### Why Choose Pentadyne Flywheels Instead of Batteries?

Pentadyne's flywheel technology provides superior performance without the high cost of ownership and the environmental impacts that batteries present. Further, due to the unique operating features such as rapid recharging and broad operating temperature range, the Pentadyne flywheel can be used where batteries have been ruled out.

	Pentadyne Flywheel	Batteries
Lifecycle Costs	<ul> <li>Very low standby costs</li> <li>Low maintenance costs</li> <li>Low installation costs</li> <li>Small footprint and light weight</li> <li>Long life</li> </ul>	<ul> <li>Large float and cooling costs</li> <li>High maintenance costs</li> <li>Air conditioned room required</li> <li>Large footprint and heavy</li> <li>Frequently replaced</li> </ul>
Reliability	<ul><li>Rapid recharge</li><li>Broad operating temperature range</li><li>Remotely monitored</li></ul>	<ul><li>Slow recharge</li><li>Narrow operating temperature range</li><li>High failure rate</li></ul>

#### Save 50-70% of the cost of owning batteries

Over a 10 year period, considering the space conditioning energy requirements, high maintenance, and frequent cell replacements, the battery energy storage may cost 2 to 3 times as much as the Pentadyne flywheel system on a lifecycle basis.

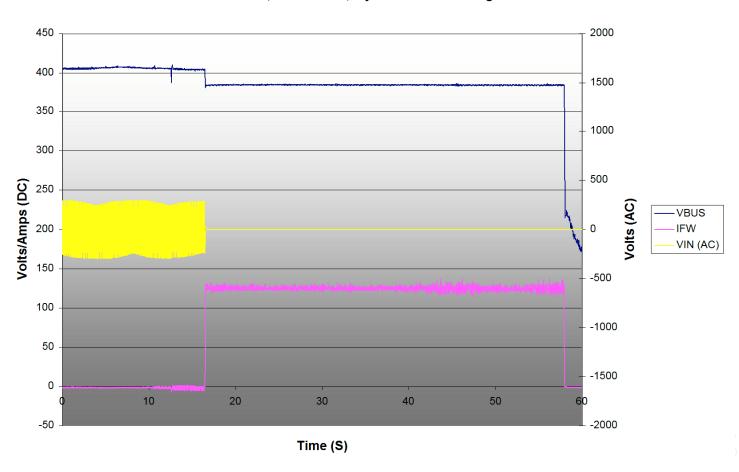
Pentadyne's flywheel technology provides ride-through power for 20 seconds or more—which exceeds the duration of 98% of all industrial and commercial power quality problems—and provides voltage stabilization during electrical disturbances. Get the facts. Contact your Pentadyne Distributor.



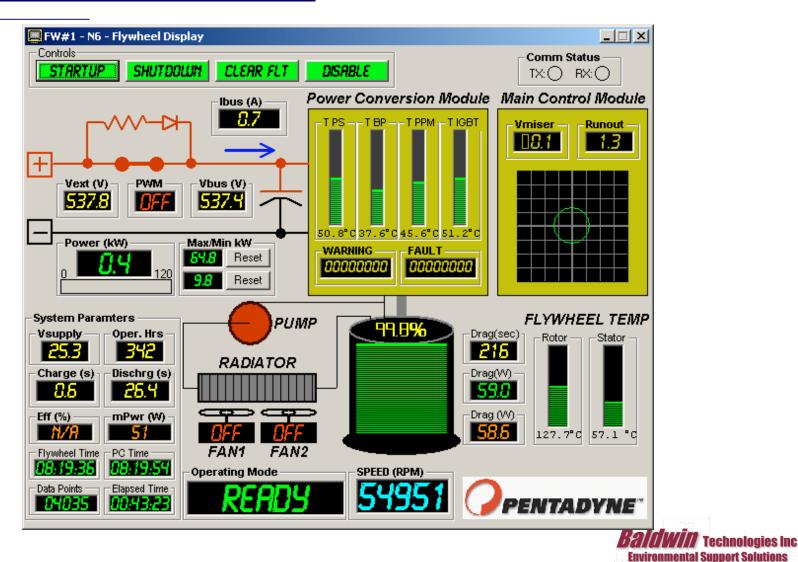
#### Pentadyne Flywheel Technology Voltage Support Solution (VSS):

System test run data below showing Pentadyne energy storage ride through for a 40kw load:

2033A, 40 kW Load, Flywheel Full Discharge



# PENTADYNE HMI



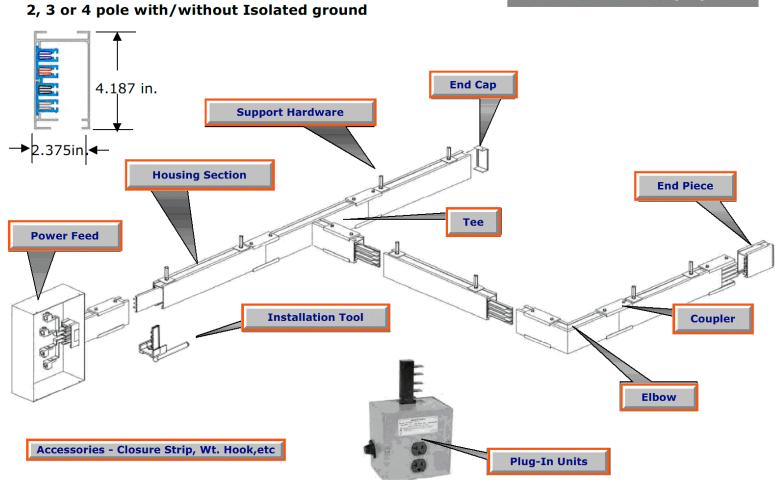
# UNIVERSAL BUSWAY FOR 500VDC DISTRIBUTION





# **RLINE** Standard B225 Amp System to 600 Volts

Also B160 or 160 Amp Systems



#### BUSWAY IS RATED AT 200Amps AT 600V DC

# **225** Amp

#### **HOUSING SECTIONS**

Track Busway housing section pressure" type copper channel busbars contained in a full length PVC insulator mounted on one side on the extrusion acts as a 100% ground path meeting UL 857 Standard and complies with Section 250 of the NEC. Each housing has an open access slot over its entire length for the insertion of turn-n-lock plug-in units.. Housing maximum rating. Each housing fit into the channels of the adjoining section. Installation tool is used to force the stabs i**nt**o the b**us**bar channels for a

MATERIAL:

Extruded Aluminum 6005-T5 unpainted 100% Ground Path 225 Amp, 600 Volt 5 Ft, 10 Ft, 20 Ft.

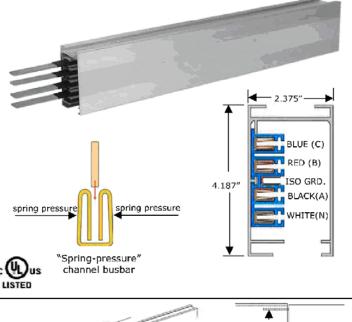
LENGTH:

INSULATION:

RATINGS:

VOLTAGE DROP:

Tool Force Housing sections are joined by inserting male end into open female end so that stabs are parallel to female slots. Installation tool is then rotated to force stabs into slots.





# DC RATED BUSWAY PLUG FOR HVDC POWER DROP









### 600VDC RATED BREAKER FOR POWER DROPS

#### **S**3 150/225A Standard thermal-magnetic









Standard S3 package includes complete crout breaker and mounting hardware. Order cable lugs as a separate item, standard copper/ aluminum (Cu/AI) lugs are no charge when ordered with breaker.

General
The S3 breaker family ranges from 15 through 225 amperes. The S3 stip
meonanisms are non-interchangeable and use sensitive electromagnetic relays
for overcurrent into protection. Heat sensitive bimetals are used for thermal
overcurrent protection. Short dirout current protection begins at 10 times the
thermal rating of the breaker and uses a magnetic coil principle.

- To meet all application needs, the S3 is available in various versions:
- T =Thermal-magnetic Q =100% UL rated

- D = Molded case switch M = Magnetic only (MCP) G = 3X Mag (100 225A 3-pole only)
- Each version is also available in different maximum fault interrupting levels
- B = 240VAC N = Normal
- H = High L = Extra high

Number of poles in UUCSA form, the S3 is available in two pole or three pole versions, both with the same dimensions. A four pole version is also available in UL/ IEC form. For price estimate, add 35% to list price of selected version three pole breaker, contact ABB Control for details.

Accessory mounting internal accessories are UUCSA approved for both factory or field installation. Accessories require control cable connectors. Shunt trips or UVR's mount in the left cavity. Auxiliary or bell alarm switches mount in the right cavity.

#### Reverse feeding

All versions of the S3 family are suitable for reverse feed applications.

UL489 switches include no overcurrent protection except for a high instantaneous trip mechanism for self protection. IEC type molded case switches with no trip protection are also available.

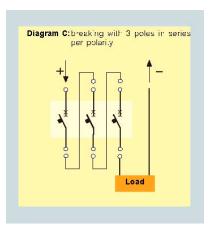


52.00				
Voltage	N	н	L	
240VAC 480VAC 600VAC 500VDC 600VDC	65 25 14 35 20	100 50 14 50 35	150 85+ 25 65 50	

#### IEC-947 Interrupting capacity (kA RMS)

Voltage	N	н	l ı
230VAC 380/400/415VAC	65	100	170
440VAC	35 30	65 50	85 65
500VAC 690VAC	30 25	40	50
500VDC	35 20	50	65
756VDC	20	35	50





### CONNECTION DIAGRAM FOR **600VDC BREAKER APPLICATIONS**





# DC SYSTEM BENEFITS

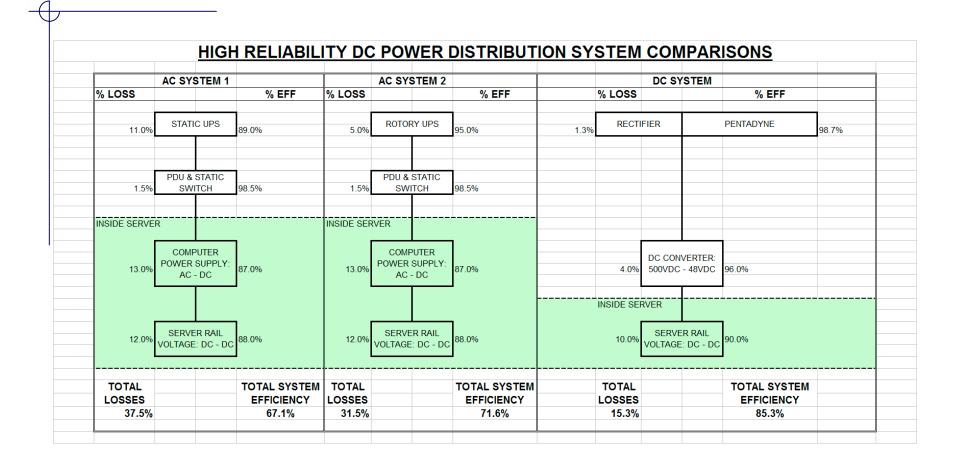
- -LOWER COMPONENT COUNT = HIGHER SYSTEM EFFICIENCIES, GREATER RELIABILITY, LESS MAINTENANCE COST & LOWER TOTAL COST OWNERSHIP
- MODULAR & FLEXIBLE: SYSTEM CAN GROW WITH LOAD REQUIREMENT
- -ENVIRONMENTALLY FLEXIBLE: SYSTEM FRONT-END COMPONENTS CAN BE LOCATED IN NON-CONDITIONED SPACES OR ON THE RAISED FLOOR NEAR LOAD
- -PENTADYNE ENERGY STORAGE ELIMINATES NEED FOR CHEMICAL BATTERIES
- -UNIVERSAL STARLINE BUSWAY PROVIDES A MODULAR "GO-AS-YOU-GROW" STRATEGY FOR DC DISTRIBUTION AS RACK POPULATION CHANGES
- -UNIVERSAL STARLINE BUSWAY PROVIDES A DOUBLE END-FEED FEATURE TO PERMIT REDUNDANT DC SOURCES AT CRITICAL LOADS
- NO DOWN-STREAM STATIC OR TRANSFER SWITCHES ARE REQUIRED, VOLTAGE MATCHED DC SYSTEMS CAN INHERENTLY BE COUPLED TOGETHER
- DC DISTRIBUTION ELIMINATES HARMONICS



# DC SYSTEM BENEFITS - CONT'D

- -SIMPLIFIED GROUNDING: POSITIVE GROUNDING OR NEGATIVE GROUNDING
- OCTAVE TECHNOLOGY MAINTENANCE MANAGEMENT SYSTEM CONTRIBUTES TO HIGHER SYSTEM RELIABILITY & COST SAVING BY EFFECTIVELY MANAGING EQUIPMENT DOCUMENTATION
- -SYSTEM CONFIGURATION IS A UNIQUE APPLICATION AND PARTNERSHIP OF EXISTING, AND PROVEN "COMMERCIALLY-OFF-THE-SHELF" (COTS) FOUIPMENT
- THIS DC SYSTEM HAS NO REQUIREMENT FOR A UPS IN ORDER TO PROVIDE HIGH SYSTEM RELIABILITY WITH UTILITY POWER OUTAGE RIDE THROUGH.
- DC DISTRIBUTION ELIMINATES POWER FACTOR CONCERNS
- REDUCES HEAT LOAD AT SERVER RACKS BY 20-40%
- REDUCES POWER CONSUMPTION BY UP TO 30%
- INCREASES SERVER RELIABILITY BY AS MUCH AS 27%







# **CURRENT RESEARCH AND TESTING ACTIVITIES**

#### ACTIVITY - 1:

■ EPRI, ECOS CONSULTING, INC., LAURANCE BERKELEY LABS - WITH INITIATION GRANT FUNDS FROM THE CALIFORNIA ENERGY COMMISSION and WITH OTHER INDUSTRY PARTNERS AND SPONSORS - "COMPARISON STUDY OF A FULLY POPULATED RACK OF DC POWERED BLADE SERVERS VS. A FULLY POPULATED RACK OF AC POWERED BLADE SERVERS "

#### ACTIVITY - 2:

 CEETHERM (Consortium for Energy Efficient Thermal Management - UNIVERSITY OF MARYLAND, GEORGIA INSTITUTE OF TECHNOLOGIES AND OTHER INDUSTRY PARTNERS - "THE NEED FOR ENERGY-EFFICIENT THERMAL MANAGEMENT"

#### ACTIVITY - 3:

JARI (Johnstown Area Regional Industries), CONCURRENT TECHNOLOGIES CORPORATION (CTC), BK ENGINEERED SALES, UNIVERSAL ELECTRIC CORP. -WORKING WITH PENNSYLVANIA BASED TECHNOLOGY COLLABORATIVES AND BUSINESS PARTNERS TO PERFORM SYSTEM TESTING AND ESTABLISH A TEAM TO BRING OUR DC-UPS SYSTEM TO MARKET



# **BERKELEY LABS**



# Calculating Energy Savings Using High Efficiency DC Power Architecture in a Server Application

Servers and other IT products in a data center run on low-voltage DC. The existing AC-based powering architecture in a data center requires multiple AC-DC-AC conversion that results in an overall system efficiency of AC-DC lower than 50%. A DC-based powering architecture reduces the number of conversion process and results in a better overall system efficiency.

This Excel-based <u>calculator</u> provides a first-order estimate of the magnitude of the energy savings based on converting an AC-based powering architecture to a DC-based powering architecture for a rack of servers. Comments/Suggestions for improving this calculator are welcome. Please send your comments to Arshad Mansoor.

http://hightech.lbl.gov/dc-server-arch-tool.html



# <u>CEETHERM</u>

#### The Need for Energy-Efficient Thermal Management

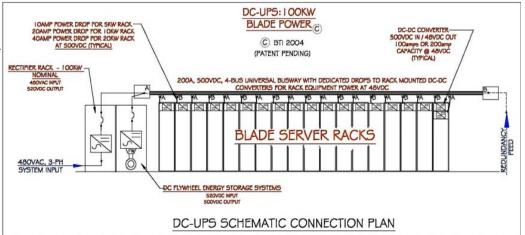
Cooling requirements for electronic and other microsystems have evolved significantly over the past two decades. As the levels of functionality and speed increase dramatically, high performance, high reliability, and energy efficient cooling techniques are urgently needed. A server farm or data center consists of thousands of racks with multiple computing units. The heat dissipation from a single rack containing such units exceeds 10 kW.

As an example, today's typical data center, with 1000 racks, occupies 30,000 square feet and requires 10 MW of power for the computing infrastructure. A 100,000 square foot data center of the future will require 50 MW of power for the computing infrastructure. The cooling for such a data center will consume an additional 25 MW of power. Such a data center could cost approximately \$45 million each year(@\$100/MWh) just to power the servers and \$22 million a year to power the cooling (Data from C. Patel, et. al, ITHERM 2002). Energy efficiency is the key to containing these costs.

http://www.me.gatech.edu/CEETHERM/Purpose.html



#### DC-UPS C DEF G H I K CRAC #1 2 3 200A, GOOVEC, 4-BUS UNIVERSAL BUSWAY WITH DEDICATED DROPS TO R-4 FOR RACK EQUIPMENT POWER AT 48VDC 5 R-2 R-3 6 RACK R-4 7 R-5 8 ERV R-6 9 DC-UPS: I OOKW BLADE POWER S 10 R-7 CRAC © BTI 2004 #2 AD (PATENT PENDING) R-8 11 R-9 12 R-10 13 PENTADYNE DC PLYWHEEL ENERGY STORAGE SYSTEMS 5200DC INPUT K. 14 480VAC, 3-PH 15 SYSTEM INPUT DC-UPS COMPUTER ROOM PLAN VIEW LAYOUT



#### **BLADE POWER** ©

- -ALLOWS YOU TO FIELD MORE BLADE SERVERS PER SQ. FOOT USING EXISTING AIR CONDITIONING
- SYSTEM PROVIDES HIGHER OVERALL POWER EFFICIENCIES
   WITH A LOWER COMPONENT COUNT
- DESIGNED FOR IT MANAGEMENT CAN BE INSTALLED ON EXISTING RAISED FLOOR AND EXPANDED BY DATA CENTER STAFF AS NEW BLADE SERVERS ARE ADDED
- PROVIDES A BATTERY-LESS UPS FEATURE AND SAVES VALUABLE RAISES FLOOR SPACE



### **CONTACT INFORMATION:**

# Baldwin Technologies, Inc.

# **Environmental and Instrumentation Support Sollutions Mark H. Baldwin, President**

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